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THINNING RESPONSE IN 110-YEAR-OLD DOUGLAS-FIR

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A study was established in 1952 near Boundary Creek in the Panther Creek area on the Wind River Experimental Forest near Carson, Wash. Site index averages 140, and aspect is westerly at elevations around 2,000 to 2,400 feet. Two minor drainages traverse the study area from east to west, creating various northwesterly and southwesterly aspects. The almost pure Douglas-fir stand was fairly well stocked before thinning, averaging 86 percent of normal basal area, although individual plot percentages ranged from 62 to 100.

This paper concerns only one objective of the study--to determine how much stands could be reduced in basal area without impairing increment.

The first report[1/] on this study, based on data up to and including 1958, described a lack of response to thinning and recommended only anticipation of mortality when partial cutting in stands of this age is planned. More recent measurements, however, imply somewhat greater response, though the recommendation may remain the same.

Nine contiguous rectangular treatment areas of at least 7.7 acres each were established in a 3 by 3 pattern (fig. 1). A 1-by 10-chain plot (1 acre) was located on the long axis of each treatment area, providing at least a 3-chain buffer strip on both sides of every plot and a small, but varying, buffer at the ends.

1/ Yerkes, Vern P. Growth after thinning in 110-year-old Douglas-fir. U.S. Forest Serv. Pacific Northwest Forest & Range Exp. Sta. Res. Note 189, 3 pp., illus. 1960.

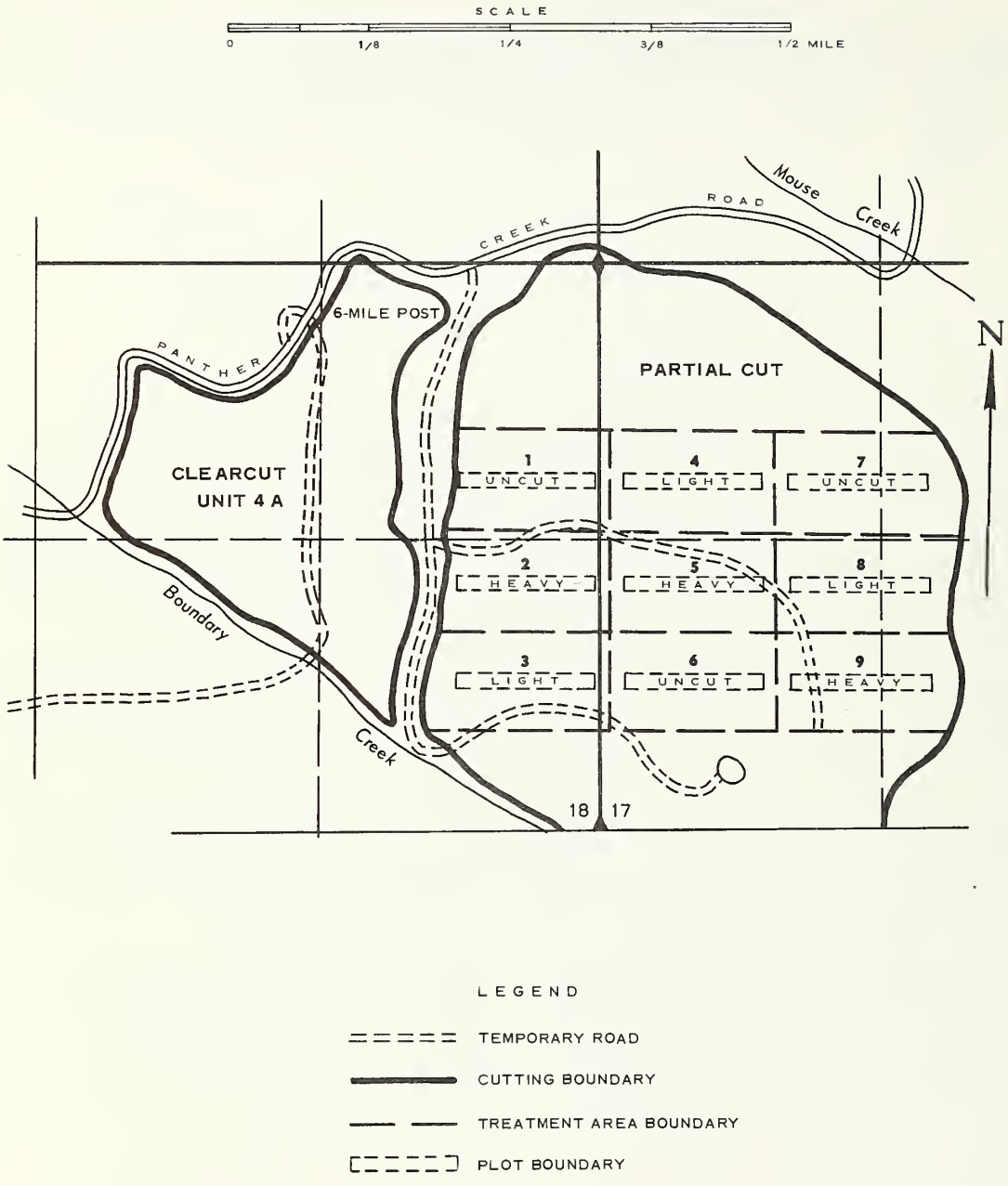

Figure 1.--Boundary Creek thinning, Wind River Experimental Forest.

Each north-south tier of three plots was treated as a block, with the three treatments randomized within each to create a randomized block design.

Heavy thinning reduced three plots to 55 percent of normal basal area; light thinning reduced three other plots to 74 percent of normal; and the three remaining plots served as checks.

Plot establishment was followed immediately by thinning in the fall of 1952. Insect-killed trees were salvaged in 1953 from most of the plots, including the check plots.

Plot remeasurements were made in 1955, 1958, and 1963. Only diameters at breast height and mortality were recorded until 1963, when tree heights were also measured.

Table 1 shows the considerable variation between plots prior to treatment. Cubic-foot volume per acre before cutting ranged from 8,500 to 14,400, averaging 11,500. Scribner volume per acre ranged from 43,600 to 77,400 board feet, averaging 58,300. In addition, two stands had much lower site indices than the other stands.

All plots are near, or have passed, the culmination of net mean annual increment in both cubic-foot and Scribner volumes (table 2). In addition, no plot is growing at a gross rate faster than 1.35 percent of the 1952 residual cubic-foot volume, with the average growth rate being 1.04 percent. Therefore, any thinning effects here would be of interest primarily to agencies whose circumstances preclude harvest of stands in this age class for another 20 years or more, principally because of even-flow sustained-yield objectives.

Also, all measures of gross annual increment over the entire 11-year period have been less on the thinned plots than on the unthinned (table 2). Gross periodic annual cubic-foot growth has been 119, 98, and 79 cubic feet, respectively, for the unthinned, lightly thinned, and heavily thinned plots.

The data tabulated below show that average gross periodic annual increment on the thinned plots increased during the latest of the shorter periods, and increment on the unthinned plots steadily decreased.

Period	Unthinned	Lightly thinned	Heavily thinned
	(Cubic feet)		
1952-55	155	104	88
1956-58	110	77	73
1959-63	104	108	76

Table 1.--Stand statistics for Boundary Creek thinning treatments at age 110 and 121 years

(acre basis)

Plot numbers by treatment and date	Site index	Total stand				Volume[1/]	
		Trees	Basal area	Average d.b.h.	Average height	Cubic	Scribner
	Feet	Number	Sq.ft.	Inches	Feet	Cu.ft.	Bd.ft.
CHECK AREA							
Plot 1:							
Before cut, 1952		115	304	22.0	146	14,424	77,450
After cut, July 1952		105	285	22.3	146	13,547	72,923
After 11 years, Aug. 1963	152	103	313	23.6	150	14,829	81,339
Plot 6:							
Before cut, 1952		147	257	17.9	134	11,855	59,310
After cut, 1952		140	239	17.7	133	10,984	57,304
After 11 years, Aug. 1963	145	131	260	19.1	138	12,148	61,952
Plot 7:							
Before cut, 1952		78	180	20.5	142	8,530	44,879
After cut, Aug. 1952		75	174	20.6	142	8,260	43,530
After 11 years, Aug. 1963	143	70	185	22.0	145	8,830	47,649
Average:							
Before cut, 1952		113	247	20.0	141	11,603	60,547
After cut, 1952		106	233	20.1	140	10,930	57,030
After 11 years, 1963	147	101	253	21.4	144	11,936	63,647
LIGHT THINNING							
Plot 3:							
Before cut, 1952		124	293	20.8	142	13,692	72,879
After cut, 1952		85	222	21.9	145	10,400	56,160
After 11 years, Aug. 1963	150	82	241	23.2	149	11,353	62,181
Plot 4:							
Before cut, 1952		106	260	21.2	143	12,384	66,168
After cut, 1952		82	215	21.9	145	10,266	55,295
After 11 years, Aug. 1963	151	77	241	23.9	150	11,501	63,466
Plot 8:							
Before cut, 1952		165	291	18.0	134	13,309	65,921
After cut, 1952		121	227	18.5	136	10,453	52,443
After 11 years, Aug. 1963	134	114	236	19.7	139	11,010	55,998
Average:							
Before cut, 1952		132	281	19.8	140	13,128	68,323
After cut, 1952		96	221	20.5	142	10,373	54,633
After 11 years, 1963	145	91	241	22.0	146	11,288	60,548
HEAVY THINNING							
Plot 2:							
Before cut, 1952		183	224	15.0	123	9,658	43,646
After cut, 1952		100	144	16.3	128	6,374	29,832
After 11 years, Aug. 1963	121	98	161	17.3	132	7,249	34,798
Plot 5:							
Before cut, 1952		131	211	17.2	131	9,604	47,261
After cut, 1952		84	163	18.8	137	7,549	38,039
After 11 years, Aug. 1963	143	82	179	20.0	140	8,398	43,289
Plot 9:							
Before cut, 1952		207	240	14.6	122	10,337	47,587
After cut, 1952		124	155	15.1	124	6,759	31,350
After 11 years, Aug. 1963	114	113	161	16.1	128	7,136	33,989
Average:							
Before cut, 1952		174	225	15.4	125	9,866	46,165
After cut, 1952		103	154	16.6	130	6,894	33,074
After 11 years, 1963	126	98	167	17.7	133	7,594	37,359

[1/] Cubic volume is entire stem volume of trees 1.5 inches d.b.h. and larger; Scribner volume is for trees 9.6 inches d.b.h. and larger to an 8-inch top.

Table 2.--Increment and mortality by treatment and subplot, Boundary Creek thinning, 1952-63

(acre basis)

Treatment and plot number	Net periodic annual growth			Periodic annual mortality			Gross periodic annual growth			Net mean annual increment[1/]		
	Basal area	Volume		Basal area	Volume		Basal area	Volume		Basal area	Volume	
		Cubic	Scribner		Cubic	Scribner		Cubic	Scribner		Cubic	Scribner
	Sq.ft.	Cu.ft.	Bd.ft.	Sq.ft.	Cu.ft.	Bd.ft.	Sq.ft.	Cu.ft.	Bd.ft.	Sq.ft.	Cu.ft.	Bd.ft.
Check area:												
1	2.5	116	765	0.2	7	30	2.7	123	795	2.74	130	710
6	1.9	106	665	.6	27	117	2.5	133	782	2.30	108	551
7	1.0	52	374	1.1	50	263	2.1	102	637	1.58	75	405
Average	1.8	91	601	.6	28	137	2.4	119	738	2.20	104	555
Light thinning:												
3	1.7	87	547	.2	5	17	1.9	92	564	2.57	121	652
4	2.4	112	743	.3	9	31	2.7	121	774	2.36	112	614
8	1.4	51	323	.7	32	161	2.1	83	484	2.48	115	574
Average	1.8	83	538	.4	15	70	2.2	98	608	2.47	116	613
Heavy thinning:												
2	1.5	80	451	.1	1	0	1.6	81	451	1.99	87	402
5	1.4	77	477	.1	4	10	1.5	81	487	1.87	86	434
9	.5	34	240	.9	40	163	1.4	74	403	2.03	88	415
Average	1.1	64	389	.4	15	58	1.5	79	447	1.96	87	417

[1/] In 1963 at age 121 years.

This relationship applies to all three unthinned plots and to five of the six thinned plots. One heavily thinned plot declined in growth during the latest period, though to a lesser extent than the unthinned plots. Also, there is no statistically significant difference in gross increment for the latest period between the unthinned and the lightly thinned plots. Current annual growth rates for both are about 106 cubic feet and 650 board feet, Scribner rule. Contributing, no doubt, to a drop in increment for all plots during the period 1956-58 was a decrease in precipitation of 50 percent from normal during the growing season for 2 of the 3 years. There is nothing to suggest that these stands were affected by the drastic freeze of 1955.

Because the heavily thinned plots averaged considerably lower in site index than the other plots, it seems unrealistic to compare their gross increment during the latest, or any, period with that of the unthinned plots, as was done with the lightly thinned plots. For this reason, a comparison was made with increment indicated by normal gross yield tables.[2/] Average periodic annual gross increment for the latest period is 85, 86, and 81 percent of normal for the unthinned, lightly thinned, and heavily thinned plots, respectively. This suggests that if all plots were of comparable site index, there would be no significant differences in gross cubic-foot volume increment for the latest period. This seems noteworthy for stands of this age after a 32-percent cut in basal area to only 52 percent of normal basal area. It is unfortunate there is no record of growth prior to treatment.

Thinning response is also indicated by increment cores from 10 dominant and codominant trees chosen in 1964 from the thinned areas. Radial growth since thinning averaged 137 percent of the growth for an equal period before thinning. This does not represent an average response because these trees were chosen on the basis of above-average release.

Mortality on the unthinned plots (310 cubic feet) has been nearly twice that of the thinned plots (165 cubic feet) for the 11-year period, but very little has been due to suppression, an indication of light stocking. Bark beetles, *Poria weirii* root rot, scattered windthrow, and blister rust of occasional white pine have accounted for most of the mortality.

After 6 years, growth on the lightly thinned (21 percent by basal area) plots caught up with growth on the unthinned plots (tabulation, p. 3). Because this growth is concentrated on fewer trees, value

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[2/] Staebler, George R. Gross yield and mortality tables for fully stocked stands of Douglas-fir. U.S. Forest Serv. Pacific Northwest Forest and Range Exp. Sta. Res. Paper 14, 20 pp., illus. 1955.

increment, presumably, will be a little higher on the thinned than on the unthinned plots. The situation is less clear with the heavily thinned plots. This study is not capable of pinpointing where permanent growth would be impaired by thinning in stands this old.

The facts reported here, although inconclusive, may help landowners decide whether they should try only to anticipate mortality with intermediate cuttings in this age class or whether they should try to increase early monetary returns through reduction of growing stock without impairing growth of the residual stand.